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ABSTRACT

Reported is a study of the relationship between degree of concept relatedness of an instructional sequence and a person's locus of control orientation. Locus of control orientation for the 541 high school biology students involved in the study was evaluated as measured by the adult Nowicki-Strickland scale. The experimental instructional treatment stressed conceptual relationships through conceptual cues and concept mapping exercises, while the control treatment did not. Dependent variables measured were scores on a meaningful learning posttest and on a six-week retention test. Two-way analyses of covariance by treatment and by locus of control resulted in a significant treatment-locus of control interaction effect for retention test scores. Subjects with an external locus of control orientation who were exposed to the experimental treatment outperformed the control group. However, students with an internal locus of control orientation retained the same amount of information regardless of treatment group.
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The Effects of Concept Relatedness of Instruction and Locus of Control Orientation on the Meaningful Learning Achievement of High School Biology Students*

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The Effects of Degree of Concept Relatedness of Instruction and Locus of Control Orientation on the Meaningful Learning Achievement of High School Biology Students

Abstract

It has been suggested that stressing conceptual relationships in an instructional unit should help students to meaningfully learn science material. It also has been suggested that locus of control orientation may interact with instructional type to affect science achievement. The purpose of this quasi-experimental study was to examine the relationship between degree of concept relatedness of an instructional sequence and an individual's internal/external locus of control orientation. The dependent variables were meaningful learning post and six-week-retention test scores.

Two instructional treatments were developed, one which stressed conceptual relationships and one which did not. Locus of control orientation was evaluated through the Adult Nowicki-Strickland internal/external scale. Five hundred and forty-one subjects at six Indiana high schools were involved in the study. Two way analyses of covariance by treatment and by locus of control orientation resulted in a statistically significant treatment x locus of control orientation interaction effect for retention test scores. Subjects with an external locus of control orientation who were exposed to the concept-related instructional treatment appeared to have retained more information than those exposed to the comparison instructional treatment. Subjects with an internal locus of control orientation retained the same amount of information regardless of treatment group. When male and female subjects were analyzed separately, the treatment x locus of control interaction effect was statistically significant for females but not for males.

Introduction and Purpose

Meaningful learning, as originally described by D.P. Ausubel, involves the linkage of new information to existing concepts and principles in a learner's knowledge structure. The hypothetical network of relationships formed during this linkage process enables a learner to recall meaningfully learned material for extended periods of time and to apply meaningfully learned concepts to new situations or problems. (Ausubel et. al., 1978) It has been suggested that, in order to enhance meaningful learning achievement, written instructional material should place explicit focus on the conceptual organization of knowledge.

(Novak, 1976) Also, it has been suggested that learning activities be designed to encourage students to concentrate on the relationships between new ideas. An example of such an exercise is concept mapping, in which students diagram relationships between newly learned concepts. (Stewart,et.al., 1979; Creager, 1979)

Few meaningful learning-related studies have evaluated any interaction effects which may exist between instructional treatments and individual attributes. There is a growing body of knowledge concerning the effects of individual differences on school learning (Cronbach and Snow, 1977), and it is important that this knowledge be applied to instructional strategies designed to enhance meaningful learning. Locus of control is a psychological variable which may have important implications for schooling. The locus of control idea was originally presented by Rotter (1966) when he suggested that individuals differ in the degree to which reinforcement is thought to be contingent upon fate, luck, or powerful others. Rotter proposed that individuals who have an internal locus of control orientation feel that reinforcement is contingent upon their own actions. Individuals who have an external locus of control orientation feel that reinforcement is derived from external factors, including fate, luck, and/or powerful others. A number of studies have found an interaction effect between degree of instructional structure and internal/external locus of control orientation. (Horsk and Slobodzian, 1980; Parent et. al., 1975; Daniels and Stevens, 1976) These studies showed that subjects with an external locus of control orientation perfomed better in high structure situations and subjects with an internal locus of control orientation performed better in low structure situations.

The purpose of this study was to investigate any interaction effect

which may be present between degree of concept relatedness of an instructional sequence and locus of control orientation. The following research hypothesis was proposed;

> On the basis of meaningful learning test scores, there will be an interaction effect between instructional treatment and internal/external locus of control orientation.

Procedure

Subjects

Five hundred and forty-one subjects were involved in the study. Two hundred and eighty-two in the experimental groups and two hundred and fifty-nine in the comparison group. The subjects were ninth and tenth grade biology students attending six high schools in Indiana: two in rural areas, two in urban, inner-city areas; and two in suburban or small-city areas. Oneway ANCVA analyses by treatment group on Otis-Lennon Mental Ability Test scores and on pretest scores showed that the two groups were equivalent on the OLMAT variable but not on the pretest variable. Data were analyzed through analyses of covariance with pretest scores as the covariate to account for the non-equivalence on the pretest variable.

Materials

The instructional materials developed for the study were entitled "Homo sapiens and the World Environment". They consisted of a study guide, a reading supplement,and an activities supplement. All subjects received identical reading and activities supplements. The study guides were divided into six sections, each of which was deductively organized around an important concept or principle. However, the experimental study guide included conceptual cues which reminded students of the importance of major concepts to related activities and readings. The ex-

perimental study guide also included concept mapping exercises at the end of each section. The comparison study guide did not include these kinds of concept learning aids. Instructional time varied among schools from 4½ to 6½ weeks.

Instruments

The instrument used to measure locus of control orientation was the 40 item adult Nowicki-Strickland internal-external (ANS-IE) locus of control scale (KR-20 r = .63). This scale has face validity when compared to Rotter's well-studied IE scale and has the advantages of a lower reading level and fewer social desirability connotations as compared to Rotter's scale. A lower score indicates a relatively internal locus of control orientation whereas a higher score indicates a relatively external locus of control orientation. Subjects were categorized as internal or external according to the overall mean ANS-IE scale score ($\bar{X}$ =12.1). Subjects with ANS-IE scale scores of less than twelve were categorized as internally oriented and subjects with ANS-IE scale scores of greater than eleven were categorized as externally oriented.

Meaningful learning achievement was evaluated through three alternate form tests (pretest, post test and six-week-retention test). Each test was made up of 25 multiple choice items and five short answer items. All of the items were designed to require application of newly learned concepts or principles to novel situations or problems as suggested by Ausubel (1978). KR-20 reliability coefficients for these tests were: pretest, .68; post test, .76; and retention test, .70. The tests were developed by the investigator and their content and theoretical validity was confirmed by three science education experts at Purdue University.

Design

The design of the study was quasi-experimental since the instructional treatments were randomly assigned to established classes rather

than to individual subjects. The primary design was analagous to the "reversed treatment non-equivalent control group design with pretest and post-test" discussed by Cook and Campbell (1979). The addition of the locus of control factor resulted in a two by two factorial design with treatment type as one independent variable, locus of control orientation as the second independent variable and achievement test scores as the dependent variable.

Results

Two-way analyses of covariance (ANCOVA) by treatment and locus of control orientation were performed on post and retention test scores. The covariate was pretest scores. For both analyses, the treatment effect was not statistically significant. The locus of control effect was statistically significant with post test scores as the dependent variable ($F = 7.5$, $p = .006$) and with retention test scores as the dependent variable ($F = 3.3$, $p = .068$). The treatment x locus of control orientation interaction effect was not statistically significant with post test scores as the dependent variable ($F = .102$, $p = .28$) but was statistically significant with retention test scores as the dependent variable ($F = 4.6$, $p = .032$). The treatment x locus of control orientation interaction effect for retention test scores is illustrated in Figure 1.

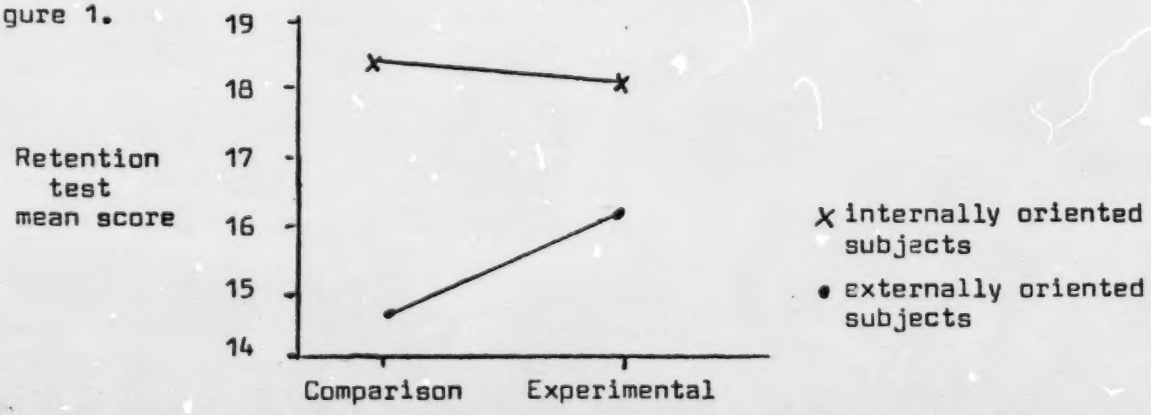

Figure 1: Treatment x Locus of Control Orientation Interaction

As can be seen from Figure 1, the treatment x locus of control orientation interaction effect was statistically significant for retention test scores because externally oriented subjects in the experimental treatment group retained more information than externally oriented subjects in the comparison group. Internally oriented subjects retained approximately the same amount of information in each treatment group. Neuman-Keuls range test results statistically confirmed this observation. Mean scores for internally oriented subjects in each treatment group were not statistically different. Mean scores for externally oriented subjects in each treatment group were statistically different ($p < .01$). Overall, internally oriented subjects retained more information than externally oriented subjects. However, the retention difference between internally and externally oriented subjects was less for subjects in the experimental group (mean retention score difference = 2) than in the comparison group (mean retention score difference = 3.7).

ANCOVA analyses by treatment and locus of control orientation were performed on retention test scores for female and male subjects separately. The analysis with females resulted in a statistically significant treatment x locus of control orientation interaction effect ($f = 2.7$, $p = .10$). The analyses with males did not result in a statistically significant interaction effect, although the locus of control effect was statistically significant ($F = 5.2$, $p = .021$). Figures 2 and 3 illustrate these relationships.

As can be seen from Figures 2 and 3, with female subjects there is an interaction relationship very similar to that illustrated in Figure 1. The similarity was confirmed by Neuman-Keuls range test analyses. The

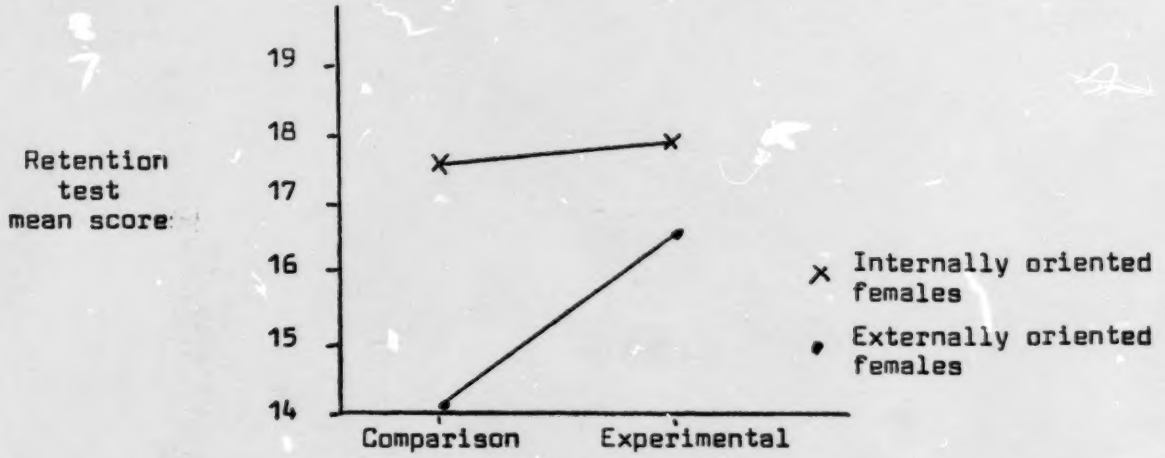

Figure 2: Treatment x Locus of Control Orientation Interaction - Females

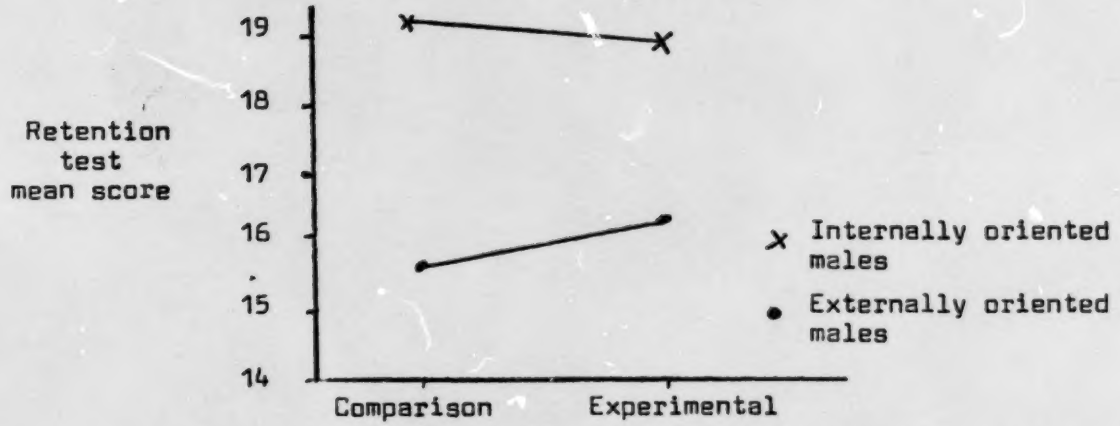

Figure 3: Treatment x Locus of Control Orientation Interaction - Males

mean scores for internally oriented females in each treatment group were not statistically different. The mean scores for externally oriented females in each treatment group were statistically different. Neuman-Keuls range test analyses resulted in no statistically significant differences between treatment groups for internally oriented males or externally oriented males.

Conclusions

The treatment x locus of control orientation interaction effect indicates that, for subjects with a relatively external locus of control orientation, the experimental treatment was more successful at facilitating meaningful learning than the comparison treatment. It appears that subjects who felt that their lives were controlled by external forces were responsive to the external learning cues included in the experimental instructional sequence. In contrast, subjects who were confident that their actions were important in determining their academic success may have ignored specific concept learning cues since they had already established useful personal learning patterns.

The fact that this interaction effect was statistically significant for retention test scores but not for post test scores may be a reflection of the "initial learning shock syndrome". Ausubel, Novak and Hanesian (1978) suggested that confusion caused by recent exposure to many ideas can cause initial learning shock which reduces achievement immediately after instruction. Initial learning shock would be a particular problem for individuals with an external locus of control orientation since they often have experienced less academic success than internally oriented individuals. (Phares, 1976) The six week time period between completion of instructional materials and administration of the retention test would have allowed any learning shock effects to subside. The six week period would not have affected the cognitive stability of meaningfully learned concepts or principles.

The difference in degree of treatment x locus of control orientation interaction effect between female and male subjects indicates that externally oriented females may be particularly responsive to specific instructional learning cues. It is possible that differential social-

ization experiences contributed to this result. For instance, females are generally considered to be more submissive in play activities and in elementary school learning situations than are males. (Sherman, 1978) Thus, females may be more conditioned to respond to external directions than males. Further investigations should be able to refine this suggestion. For example, it would be interesting to investigate the possibility that females who feel that they have little control over their lives may be more likely to follow the suggestions of others whereas externally oriented males may be more likely to trust their fortunes to fate or luck.

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